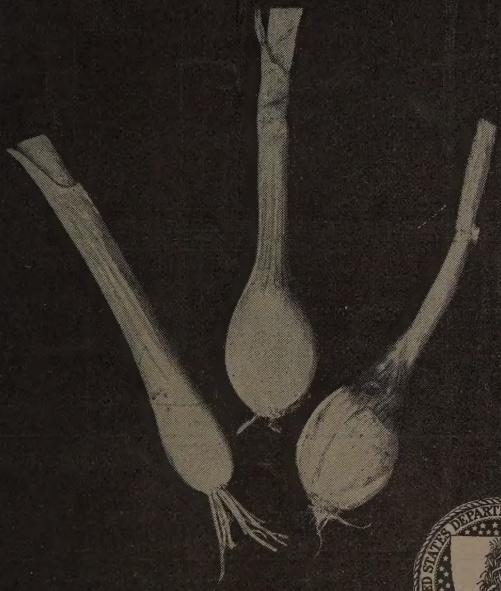
E&A
10 JUN.1919

Control of The Onion Thrips



FARMERS' BULLETIN 1007
United States Department of Agriculture

THE ONION THRIPS, a minute, prolific insect almost invisible to the unaided eye, is the most serious menace to the onion-growing industry throughout the whole United States. The damage to the onion crop alone is estimated to be at least $2,250,000 annually and, including the injuries to other crops, the loss will approximate $3,000,000 or more.

The thrips preys upon cabbage, cauliflower, and similar plants, cucumber, melons, and other vine crops, and most other garden and truck crops, though it is more injurious to some than to others. It is injurious to roses and some other ornamentals and to greenhouse plants. It also breeds upon a large variety of weeds.

Clean farming and proper crop rotation help to control the pest. Spraying with nicotine sulphate solutions has proved the most effective treatment. This bulletin gives directions for this work, with illustrations showing the outfits most effective under differing conditions.

Contribution from the Bureau of Entomology

L. O. HOWARD, Chief

Washington, D. C. January, 1919

CONTROL OF THE ONION THRIPS[1]

F. H. CHITTENDEN,
Entomologist in Charge, Truck-Crop Insect Investigations.

CONTENTS.

	Page.
Manifestation of injury	3
Description	3
Distribution	4
Life history and habits	4
Conditions favoring infestation	4
Life history	6
Food plants	7
Natural control	7
Methods of control	8
Clean methods of farming	8
Methods of control—Continued.	Page.
Danger in growing from sets	9
Crop rotation	9
Stimulating growth	9
Spraying with nicotine sulphate	10
Effect of nicotine sulphate on the plants	11
The use of soaps	11
Danger of burning plants	11
Spraying machinery and equipment	12
Hints to the onion grower	16

MANIFESTATION OF INJURY.

THE ONION THRIPS, incorrectly called "thrip" and "onion louse," is an insect of almost microscopic dimensions. It causes injury to the onion crop practically throughout the United States, producing a condition somewhat generally known in different sections as "white blast," "white blight," and "silver top." (See fig. 2.) It is also the cause of "scallions" and "thicknecks"—undeveloped and unmarketable bulbs. (See figs. 3 and 4.) In aggravated cases whole fields, and sometimes large areas comprising an entire onion-growing region, are rendered nonproductive and in extreme cases the crop is completely destroyed. The whitened appearance of the onion leaves and tops is due to the extraction of the plant juices, first by rasping and then by suction. In a short time after attack begins the leaves become characteristically whitened, then curled, crinkled, and even twisted, and finally die down permanently.

DESCRIPTION.

The onion thrips is microscopic in all of its stages. The general appearance of both sexes, which are very similar, is shown, highly magnified, in figure 1. The adult insect is at first pale yellow, but later turns brown, with the abdomen somewhat darker. The wings are still paler yellow, with dusky fringes and bristles. The length is only about one twenty-fifth of an inch.

[1] *Thrips tabaci* Lindeman.

DISTRIBUTION.

The onion thrips was introduced from Europe and was first noticed in the United States in 1872. Its spread was very slow until the year 1907, when it appeared simultaneously all over the United States. It is widely distributed in North America, occurring wherever onions are grown, as also in other regions from the Atlantic to the Pacific and from Canada to Mexico. It also inhabits the West Indies and the Bermudas, where it attracted considerable attention before the 1907 outbreak mentioned.

FIG. 1.—Adult of the onion thrips. Highly magnified.

During all of the past 11 years injury has been more or less noticeable in the States of Indiana, Texas, New York, New Jersey, Maryland, Virginia, Colorado, California, and in the District of Columbia, and to a somewhat less extent in Ohio, New Mexico, Tennessee, Mississippi, Connecticut, Idaho, Illinois, Michigan, Louisiana, Pennsylvania, Florida, North Carolina, Arkansas, Iowa, Washington, and Oregon. It has also attracted attention in Canada.

LIFE HISTORY AND HABITS.

CONDITIONS FAVORING INFESTATION.

The onion thrips appears in practically all cultivated fields in the United States, as well as in many uncultivated areas where suitable food plants for its sustenance are to be found, so that there is always danger of injury to onions and other susceptible crops, whether grown in new or old land.

Observations tend to demonstrate that in some localities at least the previous crop makes little difference as to infestation. Nevertheless, taking the country at large, there is always grave danger of infestation to onion fields where crop rotation is not practiced, and where onions follow onions, cabbage, cauliflower, or other plants favored by this pest, and where culls and other refuse from onion beds are allowed to accumulate in and near fields to be replanted to onions.

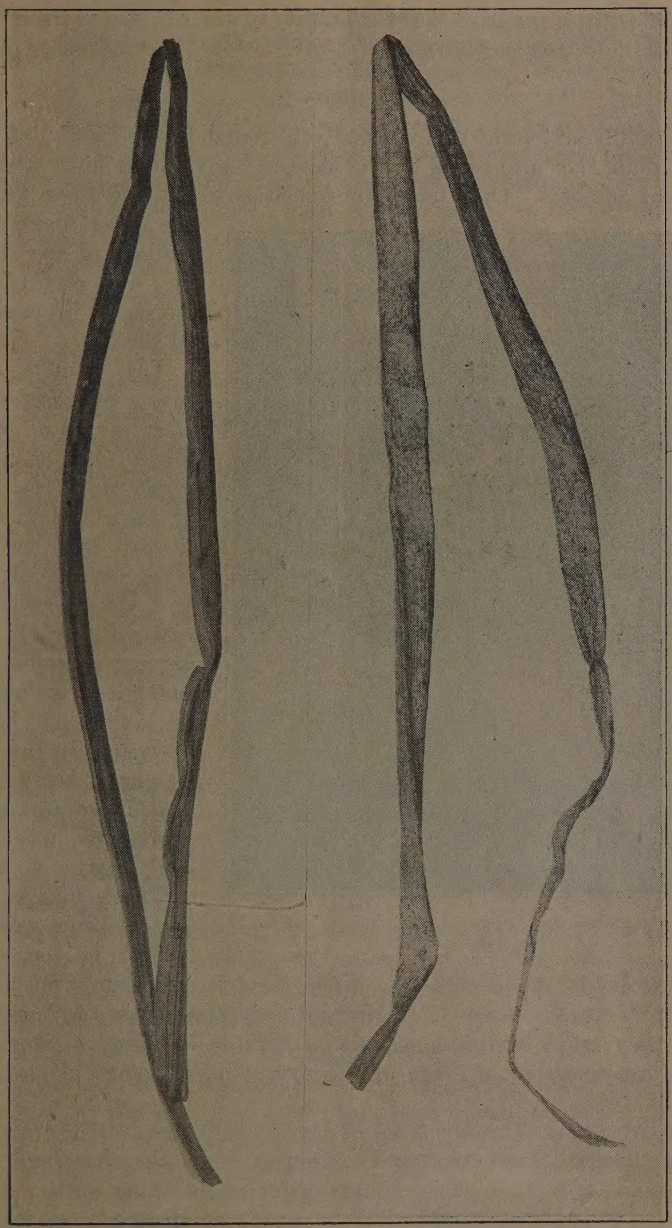


FIG. 2.—Onion leaf showing injury by onion thrips at right; uninjured leaf at left.

There is little evidence that the quality of the soil has in itself any particular bearing on the degree of infestation of the onion or other crop.

LIFE HISTORY.

The adult or parent thrips usually is found in the "bud" of the onion plant, not appearing on the leaves to any extent until present in great numbers. On other plants, such as weeds, the onion thrips are often found embedded in the flowers, and usually occur on the lower sides of the leaves.

FIG. 3.—"Thickneck" onions, a deformation caused by the onion thrips.

The female, by means of a tiny saw-like organ with which she is provided near the end of the abdomen, cuts a slit, in a leaf or stem usually, and in this slit deposits an egg, generally inserting it under the outer layer, where it is concealed from view. Here the egg hatches in a few days and the young thrips works its way out and begins to feed.

The young thrips suck the juices of the plants in the same manner as do the adults, and since they feed continuously their growth is rapid. In one or two weeks, depending upon the temperature, they cease feeding and seek a suitable location in which to transform to the final stage of the nymph and from that stage to the adult.

The life cycle from the time of laying the eggs until the maturing of the adult has been found to require, under the most favorable conditions—i. e., in a warm temperature—about three weeks. Half a dozen generations might thus be produced during a season, at least in the semitropical portions of southern Texas, where this species abounds.

FOOD PLANTS.

Besides onions, garlic, and related plants, the onion thrips injuriously attacks cabbage, cauliflower, parsley, cucumber, melons, pumpkin, squash, kale, turnip, tomato, lettuce, beets, beans, peas, celery, blackberry, strawberry, and practically all vegetable and truck crops. This includes potato, sweet potato, and mustard, plants which are seldom severely injured. It is quite troublesome, however, on ornamental plants; indeed most serious injury is frequently caused to roses and carnations in greenhouses, the damage sometimes amounting to the destruction of entire plantings. Greenhouse cucumbers frequently suffer severe losses. The premature dropping of tomato blossoms is frequently attributed to this pest, although sometimes due to other causes, such as improper use of fertilizers and unfavorable temperature and moisture conditions.

FIG. 4.—"Scallions," undeveloped onions due to the work of the onion thrips, at left; normal onion, for comparison, at right.

Among other crops tobacco has been reported injured by this thrips in Europe, but not in America, so far as we know, and there are records of injurious occurrences on cotton, timothy and other grasses, clover, rye, and wheat.

The onion thrips breeds freely on a great variety of weeds, a list of which would fill considerable space. Some of the commoner weeds affected include dandelion, daisies, mullein, catnip, goldenrod, ragweed, aster, smartweed, and wild grasses.

NATURAL CONTROL.

Rains, and especially heavy, driving storms, frequently destroy great numbers of thrips, a fact which has come under the notice of practically everyone who has studied this group of pests. Among other factors of natural control are beneficial ladybirds of several species, the spotted ladybird[1] (fig. 5) leading in this respect. The convergent ladybird[2] is also prominent as a thrips destroyer. About the second in importance is the so-called insidious flower-bug.[3] It is also destroyed by internal parasites and many other insect enemies are known.

[1] *Megilla maculata* De Geer. [2] *Hippodamia convergens* Guér. [3] *Triphleps insidiosus* Say.

METHODS OF CONTROL.

The methods of treating onion fields affected by the onion thrips are somewhat complicated because we can not place reliance on any single method, but rather on a combination of several. Kerosene-soap emulsion and fish-oil soaps applied as sprays afford some relief, but tobacco and nicotine extracts are the best direct remedies.

Because of their minute size, which enables them to conceal themselves in the sheaths of onions and in similar locations, thrips are difficult to reach. They are more susceptible to insecticides in the younger stages; hence remedial measures should be undertaken early in the season to act as preventives rather than cures.

CLEAN METHODS OF FARMING.

Too great stress can not be laid on the value of clean methods of field management, since the onion thrips breeds on all but a few vegetables, on many ornamental plants, is a pest in greenhouses, and develops on weeds of various kinds. After the onion crop is gathered, unmarketable and other useless material—"scallions," culls, tops, "thicknecks," and injured and volunteer plants—should be promptly destroyed by burning or deep burial and not left where the insects are very apt to spread to neighboring plants or to reinfest onions or other susceptible crops when these are planted in rotation.

FIG. 5.—The spotted ladybird, a great enemy of the onion thrips: *a*, Larva; *b*, empty pupal skin; *c*, beetle with enlarged antenna above. All enlarged.

Crops like cabbage and cauliflower, cucumber, and like plants should not be grown contiguous to onion fields, since each serves as a breeding place for the onion thrips, and if the thrips first attacks the onions it will pass over to the cabbage fields adjoining. Such a combination provides, other things being equal, that the thrips will have abundant opportunity for wintering over to attack the early plants of the next year.

It is of the greatest importance that crop remnants of whatever nature should be removed from the soil before planting, as well as

afterwards. In most cases this is accomplished by plowing and disking. The turnrows and margins of the fields should be cultivated often enough to prevent the growth of weeds, many forms of which harbor the onion thrips.

Clean culture should be observed as far as practicable throughout the season.

DANGER IN GROWING FROM SETS.

The practice of growing onions by starting them from "sets" is also an extremely common cause of early injury by the onion thrips. Considerable injury can be prevented by dipping the sets about a week before planting in nicotine sulphate at about the same strength as is used in spraying (p. 10) and then giving two dippings in the same insecticide at planting time.

Early planting is of service, especially northward.

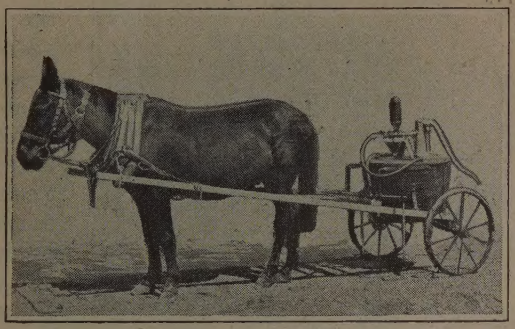


FIG. 6.—A light-weight spraying outfit suitable for spraying against the onion thrips in irrigated and bog lands. Used successfully at Rocky Ford, Colo.

CROP ROTATION.

With an insect capable of sustaining life on such a variety of vegetation, it is difficult to name an alternate crop plant that is not likely to be injured. For rotation cabbage, cauliflower, and other crops of that family, cucumber and related vine crops, and strawberry should be avoided; also ornamental plants, particularly roses and carnations, all of which are much favored by thrips. Conversely the plants mentioned should not be grown near, before, or after onions.

These plants should not even be grown in the vicinity of onion fields.

Certain other vegetables, however, such as potato, sweet potato, peas, beets, and spinach, although they may be attacked by the adult thrips, are not, as a general rule, materially damaged.

STIMULATING GROWTH.

Manure and other fertilizers should be used freely to stimulate early growth.

The onion thrips often injures the plants to such an extent that growth ceases and the plants do not again start growing even after most of the thrips have been killed by spraying. In such cases growth

should be encouraged by irrigation, cultivation, or, better yet, by an application of a quick-acting nitrogenous fertilizer. Unless this is done the thrips may become so abundant again that cultural methods will be practically useless.

A vigorously growing plant always stands a good chance of "keeping ahead" of the thrips.

SPRAYING WITH NICOTINE SULPHATE.

Onion growers should be able to control the thrips with the aid of the instructions here presented, provided they employ the proper sprayers for the purpose. Experts of the Bureau of Entomology who have been working on the onion thrips for several years past have been most successful with nicotine-sulphate solutions.

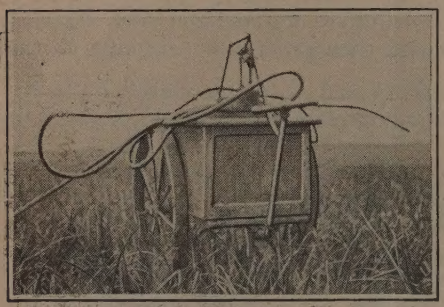


FIG. 7.—A three-wheeled sprayer supporting two nozzles, used with success in spraying onions for the thrips at Laredo, Tex.

Where nicotine sulphate is mentioned in the formula a solution containing 40 per cent nicotine is understood.

The following nicotine-spray formula has been found the best for the control of the onion thrips:

Nicotine sulphate (40 per cent)	⅝ pint.
Soap (dissolved)	4 (or more) pounds.
Water	50 gallons.

This formula gives 1 part nicotine sulphate to 1,000 parts water.

The quantity of soap required will vary with the quality of water, more soap being required in "hard" water; but on the average the proportion specified in the formula will give satisfaction. An examination of a freshly sprayed leaf will show whether there is sufficient soap in the mixture. If the spray draws together in drops, and leaves a part of the foliage dry, more soap should be added. Where possible, fish-oil soap should be used, but if it can not be procured, cheap laundry soaps will do. The composition of the cheap soaps is variable, and if too much soap is used, some injury may result to tender foliage, especially if applied in the hot sunshine.

In the use of nicotine sulphate the effective application of the spray is of the utmost importance, since it is primarily upon this that the success or failure of the treatment depends. If the liquid has stood for any length of time it should be agitated thoroughly before use. The insects themselves must receive a thorough coat of

the spray or they will not be killed, and immediate inspection after spraying should show the foliage occupied by the insects to be completely wet.

Spraying should be done always on the first appearance of the insect, not only because it is good practice to keep the plants free from pests, but because more thorough work can be done on small plants.

When spraying is once begun it should be continued at frequent intervals, as often as from 7 to 10 days, if necessary, provided there is no heavy rainfall during this period, and no surrounding breeding host for the insect. The spraying should, as a general rule, be continued up to within three or four weeks of harvest time.

FIG. 8.—Traction sprayer at work in onion field. Note small space occupied by mule at right.

EFFECT OF NICOTINE SULPHATE ON THE PLANTS.

Plants sprayed with a nicotine sulphate combination present a striking contrast to those which are not so treated. In Maryland and in the District of Columbia, a single spraying of nicotine sulphate, conducted by Bureau of Entomology experts, gave similar results, the plants doing better and a larger percentage of thrips being killed than by the use of other insecticides.

THE USE OF SOAPS.

Kerosene-soap emulsion has sometimes proved a failure in alkali regions and elsewhere and is, moreover, difficult to make with hard or alkaline water.

The addition of soap, it should be remembered, is chiefly for action as a spreader, the nicotine acting better in this combination, as it tends to wet the bodies of the insects more completely than when used alone.

Soaps are also insecticidal and are powerful agents in the destruction of small soft-bodied sucking forms of insects, such as certain plant-lice.

DANGER OF BURNING PLANTS.

Spraying with soap alone has been tested against the onion thrips, but only the standardized sorts, such as fish-oil soap, may be used

with safety, i. e., without danger of "burning," and this is more expensive than a nicotine-sulphate-soap spray when used at the proper strength. Moreover, the latter is more easily prepared. Nicotine sulphate may be obtained of most seedsmen, but fish-oil soap is not sold in all localities.

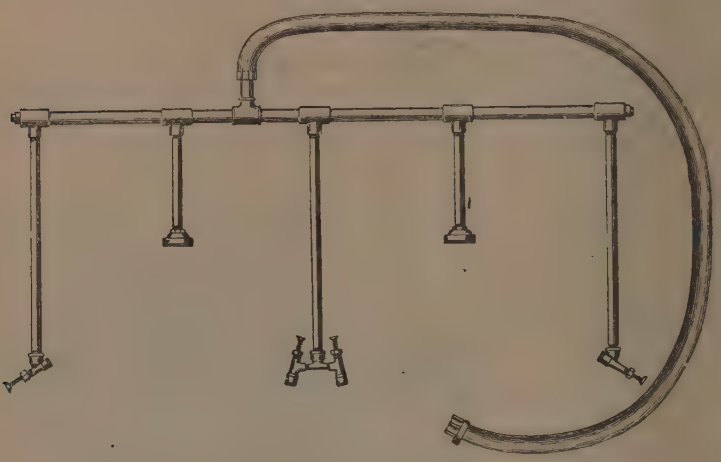


FIG. 9.—Two-row arrangement of nozzles, ready for spraying onion thrips. Nozzles in center are shown so turned as to illustrate cluster attachment. They should be directed outward and upward in use, as shown at sides, one to each row.

Complaints are frequent that injury results, even where the nicotine-soap spray is employed and the soap is used in any large quantity. There are two reasons for this: (1) In midsummer the temperature is sometimes so high in the sun that some burning may result, and (2) when the plants are badly injured by thrips, so much of the epidermis or outer skin is removed that only a neutral or mild soap can be used with absolute safety.

SPRAYING MACHINERY AND EQUIPMENT.

The question of the best spraying-machine nozzles and other apparatus for use in spraying onion fields against the onion thrips is most important. It is governed largely by local conditions and, because of the possibility of injuring the crop through the usual system of planting and type of growth, is limited in application. Apparatus suitable for the requirements in irrigated lands in southern Texas may be unsuitable for work in the bog lands of Indiana and Michigan. In Colorado, the light one-horse sprayer, illustrated in figure 6, was found to be quite efficient against the onion thrips. In that region the fields are considerably smaller than in southern Texas, and the character of the soil and method of providing irriga-

tion ditches afford better opportunity for the use of a traction type. The sprayer shown in figure 7 was successful in southern Texas, especially after the application of a boom for the purpose of holding the hose above the tops of the plants.

In spraying for thrips, the nozzles should be held well down over the plants, and the spray applied with as much force as possible, since, as has been emphasized, it is necessary to bring the solution into contact with the insects themselves, and through their habit of concealment in the leaf sheaths and the young growth of the plant they are reached with difficulty. The power is applied by a gasoline engine so that a pressure of 150 pounds or more, with consequent thorough application, is readily secured. Where onion fields may be so planted as to allow at intervals a distance of 18 to 20 inches between rows it is possible to employ a lightweight traction sprayer such as is shown in figure 8. For drawing such a type of machine

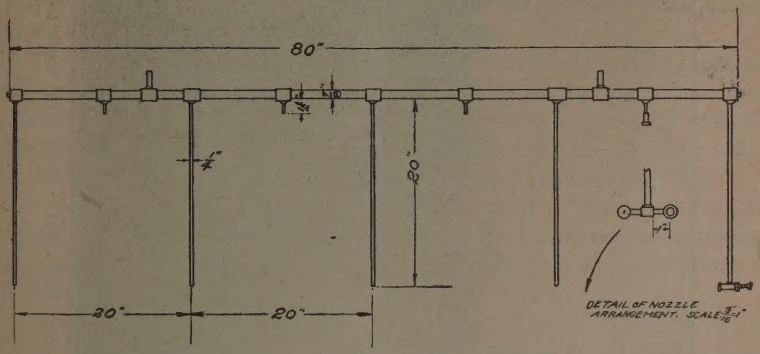


FIG. 10.—Four-row attachment for onion sprayer.

a mule is preferable to a horse, since the smaller feet are much less likely to injure the crop. Figures 9 and 10 illustrate a typical nozzle arrangement for spraying either two or four rows with a sprayer of this type. The upturned nozzles at the sides produce, in conjunction with the larger disk-type nozzle operating from above, a thoroughly effective mist-like spray.

For use in the muck lands frequently employed in the North for onion growing, a different apparatus has been more satisfactory. There the soil is so soft and spongy that serious damage frequently results to one or more rows of onions through the use of traction apparatus. A type of power sprayer which has been effectively and economically used on lands of this character in Indiana and Michigan is shown in figure 11. This sprayer derives its power from a gasoline engine and supplies, through two pipe booms, nozzle clusters provided with 3 to 4 disk-type nozzles. The boom section of pipe, which is attached to the sprayer tank and supported by guy wires,

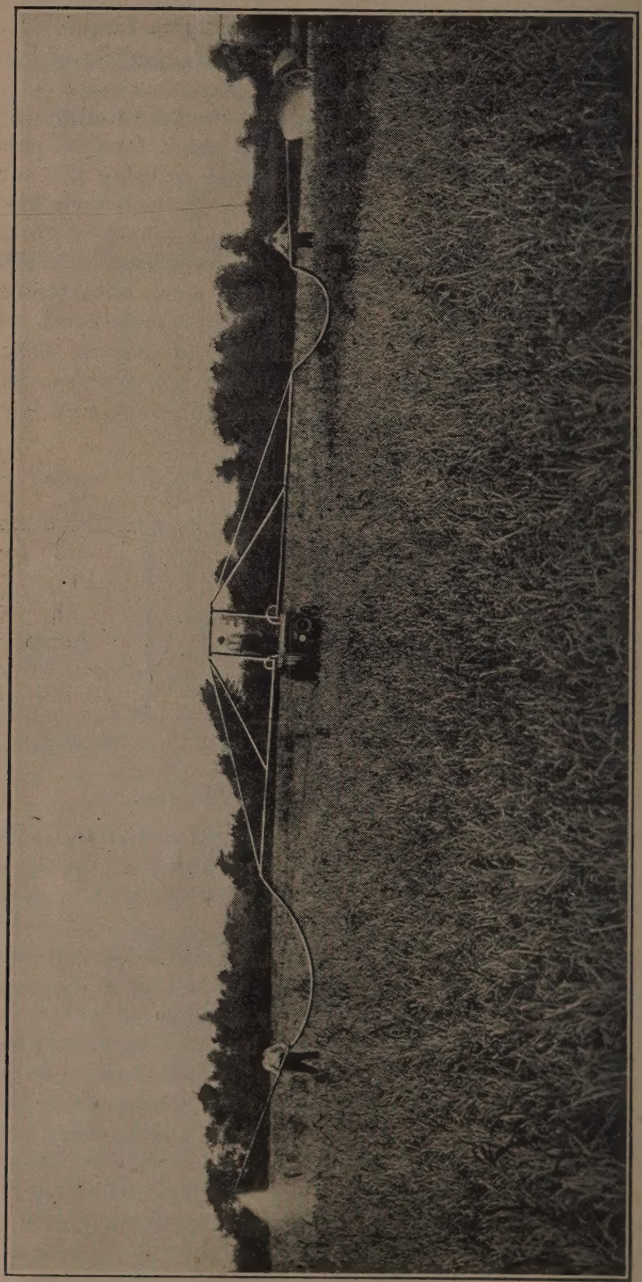


FIG. 11.—Power sprayer in operation in onion field. This type of outfit is for treatment of a strip 80 feet wide.

will swing through an angle of 180° by means of a pivot union attached at the standard. It should be placed at such a height as to clear a man's head without difficulty, that it may not hinder the operator, and should not be too long, since it may become twisted out of shape by strain. About 20 feet should be sufficient. The hose connection from the end of this boom, from 10 to 15 feet in length, attached to a 10-foot spray rod, will afford a spraying radius of 40 feet on each side of the tank. With this type of outfit a strip 90 to 100 feet in width can be treated without injury to more than one or two rows of onions in the center.

The various types of sprayers, nozzles, and other apparatus, discussed and illustrated in this bulletin, are for sale by manufacturers of agricultural implements, whose advertisements appear in the standard agricultural journals. The entomologists of the State agricultural experiment stations and the State entomologists will furnish information in regard to spraying apparatus, as will also county agents and farm advisers.

The information which has been given in regard to the treatment of onion and other fields infested by the onion thrips is based on the work of experts who have had a very extensive practical experience with the onion thrips, notably Mr. M. M. High and Mr. J. E. Graf. The following advice given under the heading "Hints to the onion grower" is adapted from information furnished by Mr. High founded on his personal experience with the onion thrips during several years' activities in the principal onion-growing regions of Texas and Indiana.

If the onion grower hopes to produce a good crop in seasons when the thrips are abundant he will do well to follow carefully the hints on page 16.

HINTS TO THE ONION GROWER.

1. Begin spraying onions as soon as the adult thrips can be seen in any numbers or the characteristic whitening of the leaves is in evidence. Do not wait until there are hundreds of young thrips and the crop is injured.

2. Spray thoroughly with nozzles which produce a fine spray, and hold them as near the plants as possible and at the same time cover infested portions.

3. Employ sprayers that will stand at least 100 pounds pressure. If the system of planting will not permit the use of power sprayers, use good hand sprayers and keep them constantly pumped up, since thrips are not killed unless the solution strikes them with some force.

4. Do not plant early cabbage or cauliflower next to onion fields if it can possibly be avoided, since it may cost you dearly with your onion crop.

5. After onion, cabbage, and related crops are harvested, clean up the field and keep it clean, because thrips continue to breed on any living portion of these plants and on almost any kind of weeds that remain in the field.

6. After harvest, plow as deeply as possible and harrow and repeat before planting the following season if onions are to be planted anywhere in the vicinity.

7. Plant as early as possible and use quick-acting fertilizers where possible after the onions are well set or the bulbs have begun to form, particularly so where the fertilizer has not been applied before planting.

8. Watch your onion fields constantly and keep the plants growing thriftily, since once the plants become checked in their growth from any cause the thrips will multiply with unusual rapidity and it will be a hard fight to save the crop.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1919